DETAILED ACTION

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-8 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Applicants are requested to point out support in the instant specification, by page and line numbers, for the limitation "in a space in which no plate member for a detour path is provided therein".

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-8, 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over EP 1101524 in view of Arno (6,905,663) and further in view of any one of Paules (4,015,546) or Pibernat (4,397,293) or Mori (2002/0150517).

EP '524 discloses a process for treating a waste gas containing fluorine containing compound (note title). As shown in Figure 1, a waste gas 9 containing PFCs, oxidizing ages, acidic gases and CO is first passed through a spray column 1 so as to remove solids and Si compounds. The waste gas is then passed through the thermal decomposition device 3, which is also supplied with H_2, O_2 and H_2O to decompose the PFCs, oxidizing gases and CO into acidic gases and CO_2. The acidic gases are removed by passage through a subsequent spray column 5, from which treated gas 10 emerges (note paragraph [0023] and the Figure). The thermal decomposition device contains an gamma-alumina packed layer as the catalyst (note paragraph [0022]).

EP '524 further teaches that as for PFC, H_2 or H_2O is added in moles at least equal to the moles necessary for F atom in the PFC to be converted into HF (note paragraph [0018]).

The differences are EP '524 does not disclose (1) the step of adding water or hydrogen to the waste gas after heating the waste gas in the presence of oxygen and (2) the step of passing the exhaust gas through a detour path formed by plural plate members.

For difference (1), Arno '663 discloses a process for the abatement of semiconductor manufacturing effluents containing fluorine gas (note title).

Arno '663 teaches that thermal approaches combine reactive materials and F_2 inside a reactor that is heated using fuel or electrical energy. Existing thermal units require the addition of hydrogen source/fuels such as methane or hydrogen to drive the

fluorine reaction to completion, converting fluorine to HF. The by-products generated by the thermal abatement of F_2 typically include hot acids that in turn require the use of a post-treatment water scrubber. The containment of hot concentration acids requires expensive materials of construction to prevent temperature enhanced corrosive attack on lines, vessels and fittings (note column 2, lines 43-58).

In order to overcome the above mentioned deficiencies, Arno '663 discloses a process for abating gaseous fluorocompounds by injecting a fluorocompound abatement medium into the fluorocompound-containing gas, wherein the fluorocompound abatement medium comprises at least one of steam (i.e. water), methane and hydrogen, optionally in further combination with a catalyst effective to enhance the abatement, with the proviso that when the fluorocompound abatement medium contains methane and/or hydrogen, the injection of the fluorocompound abatement medium is conducted under non-combustion conditions (note column 3, lines 23-33). As shown in Figures 1-2, the system used consists a gas preheating stage 6, in which the fluorine-containing gas 12 is flowed into the gas flow passage 24 bounded by passage wall 22 in aluminum block 14. The aluminum block 14 is formed in two half-sections 16 and 18. Each of the half sections has respective channels therein that upon mating the other half sections forms a first throughbore for passage of a water line 26 there through, and a second throughbore for installation of a cartridge heater 20 therein. The preheat stage 6 includes an extended length flow path through which the gas stream flows to the reaction stage 7 of the apparatus, while the water line 26 carries water from a suitable source for heating by the cartridge heater 20 to generate stream.

The generated stream then is introduced to the gas flow passage 24 at steam entrance 30, at an intermediate section of passage. The steam then mixes and reacts with the fluorine constituents of the gas stream. The heat of the reaction is dissipated by heat exchange cooling coils 32 in cooling section 8(note column 4, lines 28-63).

As shown in Arno '663, the reaction only take place in the intermediate section, i.e. reaction stage 7, thus, the HF is only formed in reaction stage 7 which can be immediately cooled down in section 8. The need for using expensive materials for construction for handling hot concentrated acid can be avoided.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to inject the water or hydrogen in the process of EP '524 into the waste gas after such waste gas has been preheated, as suggested by Arno '663, because by doing so, at least the preheat section does not require to be constructed with expensive materials that can handle hot acid.

For difference (2), Paules '546 is applied to teach that it is known in the art to use baffles in a heating zone to increase the flow path of the gas to be heated to facilitate the heat transfer, specifically as shown in Figure 7, a spiral baffle 162 extends through the heat exchange channel 160 so that the air flow is in a spiral path around the combustion chamber. The baffle 162 initially forms a relatively small helix angle, that is, the angle with a horizontal plane, and the helix angle becomes larger and constant just below the first set of discharge tubes 106a. With this arrangement the retention time of the air in the heat exchanger after its discharge into the heat exchanger 98a is increased due to the longer path provided by the baffle. Thus, preheating of the air prior

to its discharge into the combustion chamber 89a is assured (note column 11, lines 19-30). The "longer path" as disclosed in Paules '546 is considered the same as the "detour path". It would have been well within the skill of the artisan to select the actual design or shape of the baffles as long as the baffles can provide the longer path to facilitate the heating of the inlet gas.

Alternatively, Pibernat '293 is applied to a heating apparatus with a heat recovery device (note claim 1). The heat recovery device comprises at least two connected casings 4A and 4B, through which heat exchange fluid such as gas or liquids is introduced (note column 2, lines 40-48). Preferably, the casings are each provided with interior baffles 18 so as to increase the path of the heat exchange fluid, such that it recovers a maximum of heat during its passage in the recovery apparatus (note column 2, lines 46-50). The baffles 18 as shown in Figures 1-3 are considered as the claimed "plate members" and these baffles would inherently create a detour path as required in Applicants' claims 1 and 5.

The heat exchange fluid as disclosed in Pibernat '293 is considered the same as the waste gas in EP '524.

For the limitation of adding water to the exhaust gas "in a space in which no plate member for a detour path" to decompose or oxidize the fluorine compound, since Paules '546 or Pibernat '293 teaches that the baffles are used to increase the path of the exchange fluid which in turn improve the heat transfer, it would have been obvious to one of ordinary skill in the art to provide the baffles only in the area that requires heat transfer, i.e. in the heating section, not in the reaction zone.

Alternatively Mori '517 can be applied as stated below to teach that it is conventional in the art to include baffles in the heat oxidation vessel 20 to advance the removal of CO from the gas to be treated. It should be noted that the waste gas to be treated in EP '524 does contain CO (note claim 3).

It would have been obvious to one of ordinary in the art at the time the invention was made to include baffles in the process of EP '524, as suggested by either Paules '546 or Pibernat '293 because these baffles would maximize the heat transfer thereby minimizing energy cost or to promote the removal of CO.

Claims 1-8, 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arno '663 in view of EP '524 and further in view of either Paules '546 or Pibernat '293.

Arno '663 is applied as stated above.

The differences are (1) Arno '663 does not specifically disclose the presence of oxygen in the pre-heating stage 6 and (2) the step of passing the exhaust gas through a detour path formed by plural plate members.

However, Arno '663 discloses that the reaction by-products generated by the reaction between methane and fluorine gas contain 9% CO.

For difference (1), EP '524 is applied as stated above.

EP '524 teaches that it is desired in the art to not only decompose the PFC but also to convert CO in the exhaust gas to CO_2 (note last chemical equation in column 3 and paragraph [0017]).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to add oxygen, as suggested by EP '524, to the process of Arno '663 so that carbon monoxide can be converted into carbon dioxide. Since the addition of oxygen to the exhaust gas, without adding the hydrogen source, would not form any acid, thus, the oxygen can be added any time, i.e. during the pre-heating stage or the reaction stage.

EP '524 is further applied to teach the step of removing solid and water soluble component from the exhaust gas (note paragraph [0015]).

For difference (2), Paules '546 or Pibernat '293 is applied as stated above.

Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mori (2002/0150517) in view of Arno '663.

Mori '517 discloses a process for treating a gas containing fluorine-containing compounds and CO by contacting the gas with oxygen and water at a temperature of 850°C or higher to oxidize the CO to CO_2 (heat oxidation vessel 20); and then contacting the gas with gamma-alumina at a temperature of 600-900°C to decompose the fluorine-containing compounds (catalytic reaction vessel) (note claim 1 and Figure 1).

As shown in Figure 1, the heat oxidation vessel 20 has baffles which would inherently form a detour path as required in the instant claims.

Mori '517 discloses that the gas containing fluorine-containing compounds and CO is first contacted with oxygen and water to cause the reactions in the gas phase as shown by the following reactions:

$2\ CO + O_2 \rightarrow 2\ CO_2$

$CO + H_2O \rightarrow CO_2 + H_2$

$2\ H_2 + O_2 \rightarrow 2\ H_2O$

The amounts of oxygen to be added to the PFC exhaust gas is preferably at least molar amount necessary for the C atoms in the fluorine-containing compounds and the C atoms of CO which are present in the PFC exhaust gas to come to CO_2. The amount of water to be added to the PFC exhaust gas is preferably at least molar amount necessary for the F atoms in the fluorine-containing compounds to come to HF (note paragraph [0027]). This fairly suggests water is not necessary for the step of converting CO to CO_2.

For claims 3-4, Mori '517 discloses that the PFC exhaust gas treating apparatus may be combined with an apparatus for separating solid substances such as a water splaying tower to separate solid substances which might be present in the gas, or an apparatus for removing acid gas such as a water splaying tower to remove an acid gas such as HF that is obtained after the PFC exhaust gas treatment (note paragraph [0037]).

The difference is Mori '517 does not teach the step of adding water after the heat oxidation vessel.

Arno '663 is applied as stated above.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to inject the water in the process of Mori '517 into the catalytic reaction vessel instead of the heat oxidation vessel, as suggested by Arno '663, because by doing so, at least the heat oxidation vessel does not require to be constructed with expensive materials that can handle hot acid.

Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mori '517 in view of Arno '663 and EP '524.

Mori '517 and Arno '663 are applied as stated above.

The difference not yet discussed is Mori '517 does not disclose the use of hydrogen instead of water.

EP '524 is applied as stated to teach that hydrogen or water can be used in addition to oxygen to promote the decomposition of perfluorocompounds into HF and CO_2 (note the chemical reactions in column 3).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use hydrogen, instead of water, in the process of Mori '517 because EP '524 suggests that hydrogen in combination with oxygen can promote the decomposition of perfluorocompounds as well as water.

Applicant's arguments filed September 10, 2010 have been fully considered but they are not persuasive.

Applicants argue that EP '524 and Arno provide no disclosure as to the structure of the thermal decomposition means.

As stated in the above rejection, EP '524 is applied to teach the general process of treating an exhaust gas, Arno is applied to teach the step of adding water into the reaction after the preheating zone in order to prevent corrosion, and Paules '546 or Pibernat '293 is applied to teach the use of a baffle to extend the path of the gas to be heated and thereby improve the heat transfer. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Applicants argue that in Paules, the spiral baffles are not provided in the path of the refuse.

Granted that the refuse is the object that is to be treated in the combustion chamber in the process of Paules '546, however, the air that is to be preheated is considered to be the same as the fluorine-containing gas in Arno '663 and WO '524, not the refuse. The air in Paules '546 is efficiently preheated by passing through a heat exchanger having a baffle to increase the retention time due to the longer path.

Applicants argue that in Pibernat '293, during the operation of the heating apparatus, combustion air let into the heating apparatus via the combustion air inlet 1 does not pass through the heat recovery apparatus 4.

It is irrelevant whether or not the combustion air passes through the heat recovery apparatus, Pibernat '293 fairly suggests that maximum amount of heat can be recovered (i.e. improved heat transfer) when a gas stream to be heated passes through a path having baffles to increase the length of the path.

Applicants argue that none of the cited references teach passing the object to be treated in a combustion chamber through baffles.

It should be noted that Applicants' claims do not require "a combustion chamber". In any event, whether the heating is direct or indirect, Paules '546 or Pibernat '293 still fairly suggests that the use of baffles would increase the path of the gas to be heated, thereby increasing the retention time and the heat transfer.

Applicants argue that Paules discloses the use of spiral baffles 162 throughout the entirety of the heat exchange channel 160 and that Pibernat discloses the use of interior baffles 18 throughout the entirely of casing 4A and 4B of the heat recovery apparatus 4, thus, the combination of the references would require the use of baffles throughout the entirety of the treatment of the object based on the teaching of Paules and Pibernat.

As stated in the above rejection, the use of baffles as suggested by Paules or Pibernat is to facilitate the heating the gas to be heated, thus, the baffles should only be used in the heating section of Arno '663, not in the reaction section.

Applicants argue that claim 5 recites heating an exhaust gas in the presence of oxygen without adding water and/or hydrogen to the exhaust gas while passing the exhaust gas through a detour path and then adding hydrogen to the exhaust gas.

WO '524 fairly teaches that hydrogen or water can be used in addition to oxygen to decompose the fluorine compound (note claim 1). As shown in the chemical reactions in column 3, HF, a corrosive compound, is formed only in the presence of hydrogen, either in the form of H_2 or H_2O, thus, it would have been obvious to one of ordinary skill in the art to add any hydrogen or water in the process of WO '524 after the heating zone as suggested by Arno '663 to prevent corrosion.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ngoc-Yen M. Nguyen whose telephone number is (571) 272-1356. The examiner can normally be reached on Part time schedule.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on (571) 272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ngoc-Yen M. Nguyen/
Primary Examiner, Art Unit 1793

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